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NATIONAL EUTROPHICATION SURVEY

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REPORT

ON

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CONCORDIA PARISH

LOUISIANA

EPA REGION VI

WORKING PAPER NO. 536

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16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

17a. DESCRIPTORS
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lakes
nutrients
phosphorus
nitrogen
loading

17b. IDENTIFIERS/OPEN-ENDED TERMS

17c. COSATI Field/Group
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05C

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CONCORDIA PARISH, LOUISIANA

EPA REGION VI

by

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Monitoring Operations Division
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Las Vegas, Nevada

and

Special Studies Branch
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Corvallis, Oregon

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U.S. ENVIRONMENTAL PROTECTION AGENCY

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by the U.S. Environmental Protection Agency and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Louisiana Wild Life and Fisheries Commission, Division of Water Pollution Control for professional involvement, to the Louisiana National Guard for conducting the tributary sampling phase of the Survey, and to those Louisiana wastewater treatment plant operators who provided effluent samples and flow data.

Robert A. Lafleur, Chief; J. Dale Givens, Assistant Chief; Lewis R. Still, Biologist; Louis Johnson, Biologist; Lee Caubarreaux, Biologist; Darrell Reed, Engineer; Dempsey Alford, Biologist; and Elwood Goodwin, Water Quality Control Technician, all of the Louisiana Wild Life and Fisheries Commission, Division of Water Pollution Control reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper Series.

Major General O'Neil Daigle, Jr., the Adjutant General of Louisiana, and Project Officer Colonel Lawrence P. Dupre, who directed the volunteer efforts of the Louisiana National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF LOUISIANA

LAKE NAME	PARISH
Anacoco Lake	Vernon
Lake Bistineau	Bienville, Webster
Black Bayou	Caddo
Black Lake	Natchitoches and Red River
Bruin Lake	Tensas
Bundick Lake	Beauregard
Caddo Lake	Caddo (Menon and Harrison in Texas)
Cocodrie Lake	Concordia
Cocodrie Lake (Lower)	Rapides
Concordia Lake	Concordia
Cottie Lake	Rapides
Cross Lake	Caddo
D'Arbonne Lake	Union
False River Lake	Pointe Coupee
Indian Creek Reservoir	Rapides
Saline Lake	LaSalle
Turkey Creek Lake	Franklin
Lake Vernon	Vernon
Lake Verret	Assumption

LAKE CONCORDIA
Lake Sampling Site
Site Location
Scale
ISLAND
PEARLAND
LAKE
VIDAL

REPORT ON LAKE CONCORDIA, LOUISIANA

STORET NO. 2209

I. INTRODUCTION

Lake Concordia was included in the National Eutrophication Survey (NES) as a water body of interest to the Louisiana Stream Control Commission and Louisiana Wild Life and Fisheries Commission. Tributaries and nutrient sources were not sampled, and this report relates only to the data obtained from lake sampling.

II. CONCLUSIONS

A. Trophic Condition:*

On the basis of field observations and Survey data, Lake Concordia is considered eutrophic, i.e., nutrient rich and highly productive. Whether such nutrient enrichment is to be considered beneficial or deleterious is determined by its actual or potential impact upon designated beneficial water uses.

Chlorophyll *a* levels were high, ranging from 15.6 µg/l to 54.9 µg/l, with a mean of 32.9 µg/l. Dissolved oxygen was nearly depleted in the hypolimnion during the summer. Secchi disc visibility was low and potential for primary production as measured by algal assay control yield

*See Appendix C.

was high. Of the 19 Louisiana lakes sampled in 1974, 8 had higher median total phosphorus values, and 14 had higher median inorganic nitrogen levels than Lake Concordia.

Field limnologists observed scattered water hyacinths around sampling site 01.

B. Rate-Limiting Nutrient:

Algal assay results indicate that Lake Concordia was limited by available nitrogen levels during the spring. Spikes with nitrogen, or nitrogen and phosphorus simultaneously resulted in increased assay yields. Addition of phosphorus alone did not stimulate a growth response. The assay results for the fall however, suggest near-colimitation of phosphorus and nitrogen in Lake Concordia at that time.

Total inorganic nitrogen to orthophosphorus (N/P) ratios in the lake dat were 8/1 or less on all three sampling occasions, further indicating nitrogen limitation.

III. LAKE CHARACTERISTICS

A. Lake Morphometry:*

A. Surface area: 4.25 km^2.
B. Mean depth: 6.1 meters.
C. Maximum depth: 15.2 meters.
D. Volume: 25.925 x 10^6 m^3.

B. Precipitation:

A. Year of sampling: 155.8 cm.
B. Mean annual: 127.5 cm.

*Provided by the State of Louisiana.

IV. LAKE WATER QUALITY SUMMARY

Lake Concordia was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from one or more depths at each station (see map, page v). During each visit, depth-integrated samples were collected from each station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first and last visits, 10.9-liter depth-integrated samples were 2.7 meters at Station 01 and 5.2 meters at Station 02. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in IV-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in IV-B. Results of the limiting nutrient study are presented in IV-C.

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
03/19/74	1. Melosira	36,811
	2. Dactylococcopsis	2,221
	3. Cyclotella	847
	4. Flagellates	373
	5. Cryptomonas	373
	Other genera	1,288
	Total	41,963
05/30/74	1. Dactylococcopsis	4,889
	2. Nitzschia	2,606
	3. Merismopedia	2,150
	4. Flagellates	2,105
	5. Anabaenopsis	1,096
	Other genera	5,079
	Total	16,929
11/11/74	1. Dactylococcopsis	11,286
	2. Cyclotella	3,567
	3. Melosira	2,678
	4. Cryptomonas	1,099
	5. Oscillatoria	1,006
	Other genera	1,578
	Total	21,233

8. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (ug/l)
03/19/74	01	15.6
	02	17.9
05/30/74	01	49.4
	02	22.9
11/11/74	01	54.9
	02	37.0

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. 03/19/74

Spike(mg/l)	Ortho P Conc.(mg/l)	Inorganic N Conc.(mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.020	0.043	2.8
0.05 P	0.070	0.043	3.1
0.05 P + 1.0 N	0.070	1.043	17.8
1.00 N	0.020	1.043	7.6

b. 11/11/74

Spike(mg/l)	Ortho P Conc.(mg/l)	Inorganic N Conc.(mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.040	0.166	7.2
0.05 P	0.090	0.166	10.9
0.05 P + 1.0 N	0.090	1.166	23.8
1.00 N	0.040	1.166	9.5

F. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential for primary productivity was high in Lake Concordia during the spring sampling season. Increased growth of the test alga in response to an addition of nitrogen indicates that the lake was nitrogen limited at the time of sampling. Spikes with nitrogen and phosphorus simultaneously resulted in maximum yield. The addition of phosphorus alone did not produce a significant increase above the control yield.

The potential for primary productivity was also high during fall sampling. At this time assay data suggest near colimitation of both nitrogen and phosphorus. Individual spikes of nitrogen and phosphorus resulted in similar increases of assay yields.

N/P ratios in the lake data were 8/1 during autumn sampling, and 7/1 during spring and summer, indicating nitrogen limitation. (A mean N/P ratio of 14/1 or greater is considered necessary for phosphorus limitation to occur.)

It should be noted that significant changes took place in Louisiana lake samples between collection and algal assay. The assay data should be considered in this context and until such differences are resolved, used with caution for any prediction of actual lake conditions. Such chemical changes are likely to alter the assay control yield as well as modifying the N/P ratio.

V. LITERATURE REVIEWED

U.S. Environmental Protection Agency. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. National Environmental Research Center, Las Vegas, Nevada, and Pacific Northwest Environmental Research Laboratory, Corvallis, Oregon.

VI. APPENDICES

APPENDIX A

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107 x 10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX B
PHYSICAL AND CHEMICAL DATA

APPENDIX C

PARAMETRIC RANKINGS OF LAKES SAMPLED BY NES IN 1974

STATE OF LOUISIANA

69	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
68	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
67	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
66	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
65	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
64	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

63	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
62	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
61	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
60	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
59	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
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53	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
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Figure 2

| | | |